Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.44, 2017

Detection of Salmonella in Haramaya Univesity Slaughter House and Assessment of Hygienic Practic Among Slaughter House Workers, Haramaya, Ethiopia

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Abstract
Foods of animal origin are considered to be the major source of food borne salmonellosis. Knowing the source, distribution and prevalence of salmonella in slaughtered food animals and environment is necessary to prevent and control the spread of pathogens and occurrences of disease in man through contaminated animal product. A cross-sectional study was conducted from November 2014 to March 2015 at Haramaya University slaughterhouse. The aim of this study was to detect *Salmonella* from cattle carcass swab, fecal content and environmental samples (viz. cutting board, workers hand swab and Knife swab) and to assess knowledge, attitudes and practices of slaughterhouse worker's towards slaughtering hygiene. A total of 384 samples were collected from feces of cattle (77), cattle carcass swab (77) and slaughterhouse workers' hand swab (76), knife (77) and cutting board swab (77).In addition descriptive and observational studies were introduced by checklist and questioner survey on meat handlers working at slaughterhouse, to determine the hygienic status of the premises and safety practices of meat handlers. The procedures for detection of *Salmonella* were based on protocol of the ISO-6579: 2002 standard. Consequently, the suspected colonies were confirmed as *Salmonella* biochemically using Indole and Triple Sugar Iron (TSI) test. *Salmonella* was detected with overall prevalence of 8.59% (comprising of 13%, 7.8%, 9.1%, 6.5 and 6.5 of fecal sample, cattle carcass swab, cutting board, workers hand swab and knife swab, respectively).The knowledge, attitude and practices of meat handlers were found poor. This study suggests that *Salmonella* is wide spread in food animals and in slaughterhouse environment, which may pose a risk for public health. Therefore, beef meat provided to the University consumers was found to be unhygienic and poor. Thus, urgent intervention program is essential to minimize the risks associated with consumption of cattle meat contaminated with *Salmonella*. It is recommended that the use of standardized procedures in slaughtering and handling of cattle meat, provision of training on best practice of handling of meat for handlers and raising the level of awareness of people working in slaughter house is mandatory and never to be ignored.
Keywords: Salmonellosis, Haramaya University, Prevalence, Salmonella, Slaughterhouse

1. Introduction

Food borne pathogens are one of the leading causes of illness and death in the world. They place heavy burden costing billions of dollars in medical care, social costs and overall economic and infrastructure effects of countries (Fratamico *et al*., 2005). Centers for Disease Control and Prevention (CDC, 2003) estimated that 76 million people get sick, more than 300,000 are hospitalized, and 5,000 die each year from food borne illness in USA. It were mostly affects the developing countries, due to major contributing factors such as overcrowding, poverty, changes in eating habits, mass catering, complex and lengthy food supply procedures with increased international movement, inadequate sanitary conditions and poor general hygiene practices (Bhandare *et al.,* 2007; Podpecan *et al.,* 2007).

Bacterial agents of food borne diseases are uniquely adapted to the conditions established by meat production and distribution systems and may easily be introduced into slaughterhouses by farm animals that harbor them, by meat handlers or pests (Singh and Prakash, 2008). Also the slaughter process contributes to the prevalence of food borne pathogens through contamination of the carcass and cross-contamination between infected and uninfected carcasses (Horrocks *et al.,* 2009).

The slaughtering and butchering of food animals provide bacteria with an opportunity to colonize meat surfaces (Garcia-Lopez *et al*., 1998).The primary contamination of the meat surface of healthy animals is decisively influenced by the abattoir environment and the condition of the animal. The microbiology of red meat and poultry is determined by the conditions under which the animals are reared, slaughtered and processed. The most critical stage for meat contaminations are the slaughter procedures but a considerable amount of contamination is also possible during subsequent operations. Varying levels of both Gram-positive and Gram-negative bacteria constitute the initial microbial population. Adaptation and resistance to conditions on and around the meat surface (e.g. refrigeration, antimicrobial factors, reduction of a_w, and air flow, etc.) will determine which groups among the initial contaminants will eventually survive (Lawrie's, 1998).

Epidemiological evidence indicates that there is a direct link between the presence of *Salmonella* in meat

and poultry and human salmonellosis (Silliker and Gabis, 1986).Cross-contamination of carcasses with *Salmonella* can occur during slaughtering operations (Baird-Parker, 1990). Stress associated with transport of animals to abattoir augments shedding of *Salmonella* by carrier animals and this may contribute to the spread of the organism to other animals in the slaughter plant (Isaacson *et al*., 1999). *Salmonella* can also be transferred from contaminated raw foods to equipment. Surfaces, such as knives, cutting boards, and counter tops, and then from equipment to previously uncontaminated foods (Meer and Misner, 2000). *Salmonella i*s the most frequently reported cause of food borne illness (Birhaneselassie and Williams, 2013). Food borne salmonellosis often follows consumption of contaminated animal products, which usually results from infected animals used in food production or from contamination of the carcasses or edible organs (Alemayehu *et al*., 2002).

Any *Salmonella* is a potential pathogen for humans; most food borne salmonellosis is caused by non-host-adapted serotypes (Friedman *et al*., 1998).Two clinical manifestations caused by *Salmonella* are recognized: enteric fever (a severe, life-threatening illness) and the more common food borne illness syndrome. In both cases, the responsible microorganisms enter the body via the oral route. Enteric fever, commonly referred to as typhoid fever, is primarily caused by one species, *Salmonella* Typhi, but other *Salmonella* such as *Salmonella* Paratyphi are potentially capable of producing this syndrome (Mead *et al*., 1999).The incubation period varies from 6 – 48 hr and generally falls within a range of 12–36 hr. Variation in the incubation time may be attributed to the size of the infecting dose, the virulence (degree of pathogenicity) of the microorganisms, the susceptibility of the host, and the physicochemical composition of the transmitting food. As few as 15 cells can cause illness (FDA/CFSAN, 2003).

The disease is grossly underreported because it is generally a self-limiting gastroenteritis which may be misdiagnosed as intestinal influenza by the patient or the physician. As a consequence, estimates of the true incidence of disease are based on assumptions derived from epidemiological evidence. Clearly, salmonellosis continues to be an important cause of food borne disease worldwide (CDC, 2003).

Slaughtering procedures potentially involve many risks of both direct and cross contamination of carcasses and meat surfaces. During slaughter, fecal contamination of edible organs with subsequent contamination of the carcass may occur. This can be carried through all slaughter procedures up to the processing of the raw products, which are important sources of *Salmonella* in the human food chain (Edwards *et al*., 1997). Contamination of equipment, utensils and hands of workers can spread *Salmonella* to uncontaminated carcasses and parts, which can occur in subsequent handling, processing, transport, storage, distribution and preparation for consumption (Ejeta *et al*., 2004).

Although responsible for fewer outbreaks, contamination of foods by infected workers cannot be ignored as a cause of food borne salmonellosis. Some infected individuals may excrete *Salmonella* for weeks, months, and, occasionally, years with little or no evidence of disease. Improper hygiene practices by these individuals may lead to either contamination of foods or direct person-to-person contamination (CDC, 2003).

Therefore, the objectives of the study were:-

- To detect *Salmonella* from cattle carcass swab, fecal content and environmental sample at Haramaya University slaughterhouse**.**
- To find out the prevalence of *Salmonella* in apparently healthy cattle slaughtered at Haramaya University slaughterhouse.
- To determine the hygienic conditions and practices of Haramaya university slaughter house.
- To assess knowledge, attitudes and practices of slaughter house workers towards slaughtering hygiene.

2. Methods and Materials

2.1. Description of Study Area

Haramaya University is located in the Eastern Hararghe Zone of the Oromia Region of Ethiopia, which is about 17 kilometers far from the city of Harar and 40 kilometers from Dire Dawa and 5 km from Haramaya town and also located at an altitude of 1980 meters above sea level between latitude 9° 26” N and longitude 42° 3” E. The mean annual rainfall is 870 mm with a range of 560-1260 mm, and the mean maximum and minimum temperatures are 23.4°C and 8.25°C, respectively. Both local and cross breeds cattle are reared in and around the study area for meat production mostly (HADB, 2009)**.**

2.2. Study Population:

The study populations were cattle slaughtered in Haramaya University slaughter houseand environmental samples (slaughterhouse worker’s hand, knife and cutting board swab).In HU slaughter house varies from 5 -20 cattle were slaughtered per day depending on the needs of student cafeteria, staff lounge and the days of the weak. Cattle presented to the abattoirs were originated mainly from nearby localities such as Kulubi, Kersa, Dawe, Kuffa and Chelenko local markets. The animals stay for a maximum of three month at Haramaya University beef farm, but sometimes there were a time at which the animal slaughtered after stay at a farm for one week only. The animals brought for slaughter came immediately from a feed lot at the farm which is about

2.5 km away from the slaughter house.

2.3. Study samples

The study was conducted on a total of 384 samples collected from cattle carcass swab, cecal contents, slaughter house worker's hand swab, knife and cutting board swabs 77, 77, 76, 77 and 77 respectively. To determine the hygiene conditions and practices of abattoir, 20 workers were also interviewed.

2.4. Study Design

A cross-sectional study was conducted from November 2014 -March 2015 to detect *Salmonella* from Haramaya University slaughter house. In addition observational and descriptive study was introduced by checklist and questioner survey on meat handlers working at slaughterhouse, to determine the hygienic status of the premises and safety practices of meat handlers (for questioner Annexes 3 and 4).

2.5. Sampling strategy

From November, 2014 to March 2015 the sample collections were conducted every tenth day for sixteen consecutive weeks. Cattle carcass swab and cecal content samples were collected using simple random sampling method from the cattle population slaughtered on each visit to Haramaya University slaughterhouse. In addition to this, environmental sample were taken from cleaned and dry surfaces of abattoir worker hands; Cutting board (table) and knife during each visit. Matched samples were collected from each animal (Cattle carcass swab and cecal content) and environmental sample (Knife swab and Cutting board).To determines the hygiene conditions and practices of abattoir, 20 workers were randomly selected from Haramaya University slaughter house were interviewed in the study period.

Table 1: Number and types of sample collection

Sample types	Unit/sample	N
Cattle carcass swab	400 cm^2	77
Cecal content	10 ml	77
Workers' hand swab	both hands	76
Knife swab	2 sides	77
Cutting board	400 cm^2	77
Total		**384**

2.6. Determination of Sample Size

The sample size required for this study to identify the presence of food-borne pathogen from beef samples was determined according to Thrusfield (2007).

$$n = \frac{1.96^2 \times P_{exp}(1-P_{exp})}{d^2}$$

Where: n = the required sample size
P_{exp} = expected prevalence
d= desired absolute precision.

Therefore, by using estimated prevalence of 50 % food borne pathogens in samples and taking a confidence interval of 95% and 5% absolute precision, the calculated sample size required for this study were 384. Eventually, these 384 samples were distributed purposively among the proposed sample types (77 cattle carcass swab, 77 cecal content, 76 workers' hand swab, 77 knife swabs and 77 cutting board swabs) based on the number of slaughtered animal each day at Haramaya University slaughterhouse.

2.7. Questionnaire Survey

In addition to detection of *Salmonella* from the proposed samples, structured and pretested questionnaire have been used to gather information about the hygienic conditions of the slaughterhouse and the workers' knowledge and attitudes regarding to slaughtering process as well as prevention of food borne illness, food hygiene, measures for control and prevention of food borne illness were collected. An observational checklist was used to assess environmental hygiene, cleanliness of food, and food handling practices during each visit. The questioner was constructed in English, but during the interviews, the interviewers were translating the questions into the preferred language of the respondents; Amharic and Afan Oromo. A total of 20 respondents were interviewed on a once-off basis during working hours with no prior notice of the interview. Explanation on the purpose of the study was given before and the respondents were also assured about the confidentiality of their status.

2.8. Sample collection and transportation

2.8.1. Carcass sampling

During each visit, four different sites of the carcass (viz., ribs, neck, flank and hind leg) were swabbed using the method described in (ISO17604, 2003), one site covering 100 cm^2 by placing sterile template (10 x 10 cm) on a

carcass. For each sampling area, a sterile cotton tipped swab (2 x 3 cm) fitted with shaft was moistened in an approximately 10 ml of buffered peptone water, was rubbed first horizontally and then vertically several times across the carcass surface. On completion of the rubbing process, the shaft was broken by pressing it against the inner wall of the test tube and disposed leaving the cotton swab in the test tube. The four swabs were put into one screw cupped test tube containing 10 ml of sterile bacteriological peptone water. The samples were labeled and transported using ice box to Haramaya University Microbiology Laboratory for microbiological analysis and analyzed upon arrival or within 24 hours of sampling.

2.8.2. Fecal sampling

The fecal sample was collected immediately after evisceration from cecal contents of slaughtered cattle; an aseptic incision was made with surgical blade in the cecum to obtain a representative sample (10 ml) of the cecal content. The fecal material was aseptically compressed and the resultant liquor decanted in sterile universal bottle, labeled, transported on ice box to the laboratory and held in a cold storage over night and processed the following day.

2.8.3. Environmental sampling

At each slaughter visit, three types of environmental samples were collected by swabbing the slaughterhouse workers' hand, knives and cutting board. For knives, composite samples were collected from the blade and handle of the knives. The swabs will then returned to a test tube containing 9 ml sterile buffered peptone water (BPW). All samples were transported to Haramaya University Veterinary Microbiology Laboratory using an ice box on ice packs and analyzed upon arrival or within 24 hours of sampling.

2.9. Detection of *Salmonella*

The procedures for isolation of *Salmonella* were based on protocol of the ISO-6579: 2002 standard. To diminish the risk of obtaining false negative results, a non-selective pre-enrichment of large food sample, a combination of two selective enrichments and plating on two selective media was performed:

1. Pre-enrichment in non-selective medium (buffered peptone water).
2. Selective enrichment in Tetrathionate broth (Müller-Kauffmann) and Rappaport-Vassiliadis.
3. Sub-cultivation on Xylose Lysine Desoxycholate (XLD) agar and on Brilliant Green Agar (BGA) in parallel.
4. Colonies resembling *Salmonella* on Xylose Lysine Desoxycholate (XLD) and Brilliant Green Agar (BGA) was confirmed using TSI (Triple Sugar Iron) test and Indole tests (ISO-6579, 2002).

A typical *Salmonella* colony has a slightly transparent zone of reddish colour and a black centre; a pink-red zone may be seen in the media surrounding the colonies on XLD agar and typical *Salmonella* colonies on a Brilliant Green Agar (BGA) plate cause the colour of the medium to be red/pin and white opaque colonies surrounded by brilliant red zones. Presumptive colonies of *Salmonella* were further be tested by colony pigmentation as was being non-lactose fermenting (NLF), TSI, Indole negative and Hydrogen sulphide (H_2S) producing. On Gram staining *Salmonella* are Gram negative rod shaped organism (ISO-6579, 2002).

2.10. Data Management and Analysis

The data collected through questionnaire survey and laboratory were entered into Micro-Soft Excel computer program and analyze using SPSS (SPSS version-16.0). Descriptive statistics were used to describe the nature and the characteristics of the questionnaire survey result as well as for the determination of prevalence in the different samples.

3. Results

Out of the total of 384 different samples examined, 33 (8.59%) were found to be contaminated with Salmonella. *Salmonella* was isolated from cecal contents 10(13%), pooled meat 6 (7.8%), cutting board (table) 7(9.1%), workers hand 5(6.5%) and knife 5(6.5%).

Table 2.Prevalence of *Salmonella* isolates from food cattle and slaughterhouse environment

	Number of sample		
Source of sample	**Examined**	**Positive**	**Percentage (%)**
Cecal content	77	10	13
Cattle carcass swab	77	6	7.8
Cutting board	77	7	9.1
Workers' hand swab	76	5	6.5
Knife swab	77	5	6.5
Total	384	33	8.59

Aside from laboratory results, questioner results also show the knowledge, attitudes and practices of abattoir workers in relation to important parameters that potentially can influence the quality and safety of cattle meat. Only 20% of the respondents were educated up to high school and 70% of them were at elementary school

level while 10% of them were illiterate. Among the twenty (20) workers, sixteen (16) acquired butchering skill from observations, four (4) from their parents in their house and none of them had formal training on how to butchering should be conducted. More than 65% of the workers reported that they clean their knife every day at the end of butchering using only water and only two (2) persons clean their knife with water between works. More details on worker's knowledge, attitudes and practices of abattoir workers in relation to important parameters that potentially can influence the quality and reason for carcass contamination summarized in (Table 3).

Table 3.Result on assessment of knowledge, attitudes and practices of abattoir workers

Factors	Values	Frequency	Percentage (%)
Educational status	Illiterate	2	10
	Grade 1-8	14	70
	Grade 9-12	4	20
	Collage	0	0
Occupation in	Butcher	14	70
	Meat inspector	1	5
	Sanitary	3	20
	Other	1	5
Experience	<1 year	7	35
	2-5 years	9	45
	6-10 years	3	15
	Above 10 years	1	5
Job related training	Yes	20	100
	No	0	0
When Cleaning knife	Before work	4	20
	End of work	13	65
	When excessively soiled	1	5
	Between work	2	10
Manner of cleaning knife	Using soap	0	0
	Water only	20	100
Cleaning floor	Before work	1	5
	End of work	4	20
	Between work	13	65
	When excessively soiled	2	10
Sanitary regulatory system	Yes	3	15
	No	17	85
How they get butchering skill	Observation	16	80
	Parents	4	20
	Formal training	0	0

The respondents were questioned fortheir personal hygiene andabout protective cloth they are using. Washing the hands is practiced by only eleven (11) of the interviewees and sixteen (16) persons did not regularly put on clean hair cover at work. Only eight (8) of them wash their hands with only water after work, while nine (9) workers did not wash their hand at all.Most of the worker not uses protective cloths. The personal hygiene practices of study area slaughter house worker are summarized in (Table 4).

Table 4. Result on assessment of personal hygiene of slaughterhouse

Factors	Value	Frequency	Percent (%)
Wash hand	Yes	11	55
	No	9	45
Manner of washing hand	Using soap	3	15
	Water only	8	40
	Not wash	9	45
Used Protective clothe	Yes	14	70
	No	6	30
Protective clothe	Always	2	10
	Usually	10	50
	Sometimes	2	10
Hair cover	usually	0	0
	Rarely	4	20
	None	16	80
Gumboots	Yes	15	75
	None	5	25
Jewelry	Worn	2	10
	Not worn	18	90
Finger nails	Short polished	12	60
	Short not polished	6	30
	Long polished	1	5
	Long not polished	1	5
Smoke cigarette	Yes	7	35
	No	13	65
When Smoke cigarette	Before work	0	0
	End of work	0	0
	Between work	6	30
	At break time	1	5
	Not smoke	13	65

Direct observations revealed the animal brought to slaughterhouse from the farm by simply selecting the animal in the night at 10 PM without prior ant mortem inspection was done and without fasting of the animal for 12 to 24 hours before slaughter which increase the micro floral load and also during slaughter inhumane mechanical stunning process was also conducted, this all practice which were conducted result stressfully condition, suffering and pain on the animal. In addition these pre-slaughter stressful conditions facilitate the rapid multiplication and shading of *Salmonella* spp., which could be the major source of contamination of meat. In addition the ways they remove gastro intestinal tract were may be the major source of contamination of carcass and other edible organ. Also Haramaya University slaughter house premise has not well-designed and constructed structure to satisfy the systematical animal slaughter process and the general requirement and standard.

Observation study indicates the absence of hot water, and carcass retention room in the abattoir. Water was stored in an open water barrel and used to wash the floor, carcasses, hands and equipments. During slaughtering equipments are placed on unclean surfaces. Knives were placed on the floor, on the skin of killed and in the anus of a slaughtered cattle. The protective clothes were unclean, blood tinged and frequently contact with carcasses; however hair cover were not used. There were no separate compartments for final carcasses and animals to be slaughtered. The procedures of cleaning and disinfection of the surface, a notably low percentage and the respondents indicated that predominantly running water was used to clean the surfaces, whereas majority of them cleaned their knives whenever they were excessively and visibly soiled with fat or blood before the commencement of work each day. Veterinary meat inspectors were always not present in the slaughterhouse for inspection; it was conducted by the manager instead.

4. Discussion

To the best of our knowledge this is the first study of the prevalence of *salmonella* in Haramaya University slaughterhouse. In the present study, 10(13%), 6(7.8%) 7(9.1), 5(6.5) and 5 (6.5) cecal contents, cattle carcass swab, cutting board (table),workers' hand and knife respectively were salmonella positive.

About 7.8% of samples from slaughtered cattle meat were positive for salmonella. This is particularly important in Ethiopia where raw and uncooked meat is consumed. The findings of this study do not differ greatly from those reported the isolation of this bacteria from cattle meat in other areas of Ethiopia. This has already

been reported in two studies, 7.1% by (Alemayehu *et al*., 2003) and 5.6% by (Molla *et al*., 2007) in Bushoftu town of Ethiopia. However, the result was higher than that in previous reported by (Sibhat *et al*., 2011) 2% and (Molla *et al.,* 2003) 4.2%. This could be associated with poor hygienic practices and facilities in slaughter house which can exacerbate the contamination of carcass and other edible organ, hygienic conditions of holding pens, and stress from stunning method this slaughter house use. Cross contamination can occur also during skinning processes as a result of poor hygienic practice.

Of the sample types taken from each worker during the study period, slaughter house worker hand palm samples proved to be useful indicators of infection, as some of Salmonella positive result were detected on the basis of those samples. The prevalence distribution of *Salmonella* isolate was 6.5% in slaughter house worker hand palm, which compared well with the respective 6.0% prevalence reported by (Molla *et al*., 2003*)*. Washing of hand with soap and running water for 15 seconds, is, need to remove inoculums of 100 or less of salmonella from finger trips. But heavier inocula leave viable salmonellae on the hands even after such washing (Watson, 1995). Similarly Smeltzer *et al.,* 1980 indicated that washing hand is an essential part of any program aimed at reducing cross contamination of carcass with salmonella.

In present study 6.5% *salmonella* prevalence from knives obtained in this study is nearly similar with the 7.4 % prevalence of knives study in Modjo abattoir house by (Teklu and Nugussie, 2011).

The detection of *Salmonella* in cecal contents of slaughtered cattle is of significance in food safety as this can easily result in contamination of carcasses and edible organs. The prevalence of present study of *Salmonella*in slaughtered cattle was higher than those in previous reports (Nyeleti *et al*., 2000; Alemayehu *et al*., 2003) and (Sibhat *et al.,* 2011). The difference in the reported prevalence could be associated with bacteriological technique employed in detecting *salmonella* or difference in occurrence and distribution of salmonella in the study population regardless of test sample and method of detection. It is also known that keeping animal to be slaughter in crowded waiting pens at abattoir could facilitate the excretion and transmission among them. In addition to this stress from in humane stunning may also increase the shedding of salmonella with feces (Woldemariam *et al*., 2004).

In this study slightly higher detection rate (13%) was observed for *Salmonella* on feces in comparison with sample from swab sample of cattle carcass swab (7.8%),cutting board (table) 7(9.1%), workers hand 5(6.5%) and knife 5(6.5%).This could be associated with stress from stunning method this slaughter house used which increase the shedding of *salmonella* with feces, and the time that the animals stayed in the lairage before slaughter. This seems to be quite logical as the main source of contamination is the feces of the animal which found its way to the surface of the carcass due to poor hygienic conditions during slaughtering process of the animals (Siragusa and Cutter, 1995). Thus the detection of *Salmonella* in fecal contents of slaughtered cattle is significant in food safety as this can easily result in contamination of carcasses and edible organs.

Slaughterhouse workers play a role in carcass contamination during the slaughter process. The more important issue to avoid carcass contamination is their level of knowledge, attitude and practices towards hygiene.

In the present study 70% of slaughter house workers had only a primary school education. Surprisingly all of slaughter house workers and butchers 100% did not have job related training as regards to food hygiene but acquired their respective skills from observations. The results are in agreement with reports of (Mekonnin *et al.,*2013) and (Endale and Hailay, 2013) who reported a primary school education and lack of job relating trainings in more than half of the slaughter house workers and butchers in Mekele city, Ethiopia. Therefore, these workers could cross contaminate and not handle meat hygienically due to lack of knowledge regarding hygiene, sanitation, risk of contamination and personal hygiene. However training of food handlers regarding the basic concepts and requirements of personal hygiene plays an integral part in ensuring safe products to the consumers (Adams and Moss, 1997) and food handlers should have the necessary knowledge and skills to enable them handle food hygienically (FAO, 1990).

The slaughtering process was unhygienic and unsanitary. There was no hot water, sterilizer, soap and retention room and equipments rest on dirty surfaces. However, Akafete and Haileleul, (2011), reported that eviscerating knife significantly associated with carcass contamination and specific attention must be given to sterilization of knifes. Motsoela *et.al* (2002) also indicated that, it is salutary to note that knives must be immersed in water for two minutes at 82°C to reduce the number of contaminating microorganisms. Contradictory to these facts, in current study site the same knife was used without sterilizing to slaughter different cattle meat, for evisceration, cutting throat and skinning process. This could cause high carcass contamination with different food borne pathogens unless it is solved.

At slaughter area, the slaughter processes are done in the same area without separate dirty and clean zone, thus, the incomplete separation still can make cross contamination. Workers have less concern on hygienic practice from observation and interview and they are not equipped and/or supplied with the necessary material that enables them to maintain the general hygiene. Smoking habit and not changing clothes are major points that observed. From the survey conducted, 45% of the respondent don't wash their hand and 40% wash their hand by

water only, this clearly indicates that slaughter staff's negative attitude towards hygiene. All (100%) of the workers reported that they clean their knife every day only with water. Contradictory, water alone does not sufficiently wet to displace many types of soils or even to displace air from water- repellent or hydrophobic surfaces (Gracey *et al*., 1999).

5. Conclusion and Recommendations

This study showed that slightly higher isolation of *Salmonella* in cattle meat destined for human consumption. In addition, the results showed the risk of this pathogen to consumers due to unhygienic meat processing most commonly practiced in Haramaya University slaughter house, Ethiopia. This may be due lack of awareness among the slaughterhouse workers' about meat handling and processing and also may be due to mismanagement in the slaughter house. The higher prevalence of *Salmonella* was seen from fecal content, suggesting that feces during slaughtering process plays as the key source of microbial contamination for cattle meat and slaughterhouse environment as a whole. The study confirmed a need for preventative approach to control *Salmonella* in cattle meat production chain.

This study has also attempted to cast light on features about the knowledge, attitudes and practices of slaughter staff's pertaining food safety and general hygiene. The findings indicated that there are poor personal and general hygiene measures in place and that the workers not focus on hygienic practice. Based on the above conclusion the following recommendations are forwarded:

- Training programs must be provided on best practice of handling of meat for handlers and raising the level of awareness of people.
- The manager of the abattoir should be at a minimum level of diploma holder on veterinary science.
- Further study should be conducted to on other pathogenic microbes that may contaminate the meat and the slaughterhouse environment and pose a public health hazard.
- Whenever there is contamination of the meat with feces, it should be cleaned with water and the final consumers should be consulted not to eat the meat raw.
- Abattoir facilities such as adequate supply of potable water, knives pouches, hot water, and detergents should be supplied.
- Control measures to reduce the public health risk arising from *Salmonella* in cattle meat chain needs to be addressed at abattoir level by reducing carcass contamination at various stages of the slaughter process.

Acknowledgments

Our heartfelt thanks and sincere appreciation are goes to Haramaya University College of Veterinary Medicine for the provision of laboratory reagent and kits during the research work and staff of slaughter house for their willingness to scarify their time during questionnaire survey as well as effort made to collect samples.
Finally we are very thankful to Haramaya University laboratory assistances, for their cooperation and positive approach.

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